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Challenging social norms to recraft practices: A Living Lab approach to reducing household energy use in eight European countries

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ABSTRACT

ENERGISE is the first large-scale European effort to reduce household energy use through a change initiative that adopted a 'living lab' approach informed by social practice theory. Two challenges were introduced to 306 households in eight countries: to lower indoor temperatures and to reduce laundry cycles. This contribution demonstrates the usefulness of a practice-centered design that takes habits and routines as an entry point for understanding how different 'elements of practices' can be re-crafted. We discuss how a participatory 'living lab' approach that explicitly encouraged deliberation and reflexivity served to sharpen attention on practices as central to change. We discuss how 'doing laundry' and 'keeping warm', as very different types of practices, responded to the change initiative. For laundry, tangible changes in material arrangements, news skills and sensory competencies, and shifts in what is seen as 'normal' proved to be central to reducing wash cycles, including wearing clothes more often, airing them out, using smell to gauge cleanliness, or keeping dirty clothes out of sight. Warming people rather than spaces through added layers and activities, and related shifts in norms around thermal comfort, emerged as crucial steps towards lowering indoor temperatures. Average changes in reported temperatures and wash cycles indicate that reductions are possible, without an emphasis on individuals or technologies as central to change. We end with a discussion on the implications of our approach for energy sufficiency thinking and practice, emphasizing the merits of taking the complexity of everyday life seriously when designing change initiatives.

1. Introduction

Countries across Europe have been engaged in efforts towards reducing energy usage, while also increasing the share of renewable energy sources. Yet these so-called energy transitions have not yielded absolute reductions [1]. Increases in renewable production appear to serve largely as an 'addition' to existing energy supplies [2]. At the same time, the global consumption of goods and services continues to be a key driver of energy use and related carbon emissions [3]. The IPCC special report on *Global Warming of 1.5 °C* invokes "the need for urgent and far-

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reaching changes in practices, institutions, and social relations in society" [4], but most efforts to reduce energy use remain limited in their reach and impact – in particular where households are concerned. A recent review of over 1,000 European initiatives aimed at lowering domestic energy use found that 48% focused on individual behaviour change, followed by changes in technologies and products (26%) [5,6]. This narrow focus is not surprising, given the current dominance of behavioural economics, and rationalistic and individualistic approaches to consumption. Underpinned by information deficit assumptions and technological optimism, these approaches fail to recognize energy use as tied up with complex socio-technical systems and as embedded in everyday life.

Studies that adopt a social-practice approach to understanding energy use have grown in prominence over the years, starting with the seminal work of Shove [7]. As a social ontology for understanding everyday life, practices are seen as being made up of inter-related elements, whether 'materials, competencies and meanings' for Shove and Pantzar [8], or 'understandings, engagement and procedures' ifor Warde [9]. Social practices also "contain the seeds of constant change" [9] and shifting practices could potentially result in delivering the same uses, such as feeling warm indoors, but with less energy. Spurling et al. [10] demonstrate three ways in which practices can change: changing elements of practices ('re-crafting'), substituting one practice for another, or changing how practices interlock. Other studies show how practices have changed in the past, towards the normalization of some forms of energy use and their prioritisation over others [11–13]. How to imagine and potentially initiate future changes is a promising field of research and practice.

ENERGISE is the first large-scale European effort aimed at reducing energy use among households through a change initiative that adopted a 'Living Lab' approach informed by social practice theory. Following a review of different ways of engaging households [14,15], two challenges were introduced to 306 households in eight European countries: to lower indoor temperatures and to reduce laundry cycles. This paper presents the summary results of a practice-centered design effort that revolves around the re-crafting of 'practice elements', answering central questions in social sciences energy research: "How do conventions around energy services evolve, how do they alter over time, and how can they be changed once they are cemented?"[16]. We contribute to a growing body of research on how to work collaboratively with people to transform aspects of their everyday life, as opposed to focusing solely on changing consumption through technology, or social engineering and 'choice architecture'.

In section 2, we introduce how a change initiative can be informed by social practice theories and discuss the Living Lab approach. We then provide details on the project design in section 3. In section 4, we present project results around changes in 'doing laundry' and 'keeping warm'. We end with a discussion of insights on our approach.

2. Changing practices: the role of social norms and other meanings

A rapidly growing body of practice-theoretical work on energy use has emerged as a new and innovative strand of social-scientific energy research [7,13,17–26]. Various interpretations exist on what constitutes a social practice, building on theoretical developments from Bourdieu and Giddens, to Schatzki and Reckwitz. They share a will to overcome the structure-agency dichotomy in social theory and research, suggesting that agency can be found in practices, as a main unit of analysis and as recognizable entities, such as preparing meals or doing laundry. Such an approach "moves the focus from cognitive and rationalist theories of action to embrace a theory of agency in which past experiences and the things with which the individual interacts are regarded as important to current and future actions"[21].

Contrasting with a large body of work concerned with one-off energy saving measures such as the installation of a new heating system or the application of an energy retrofitting package to improve the thermal performance of a dwelling, this study focuses explicitly on routines and habits, that is, "entrenched practices that are recurrently and relatively consistently reproduced" [27]. While routines and habits are not the same – the former, as a set of actions that recur with predictable periodicity; the latter, a disposition towards a previously adopted action [28] – both share low reflexivity. We set out to understand what people routinely and habitually do, and in doing so we encouraged reflexivity through in-depth discussions about how everyday life relates to three inter-related elements of practices: 1) material arrangements, involving spatial organization, technologies, and artifacts; 2) skills and competencies, as part of how practitioners carry practices, in what way; and finally, 3) social norms as well as other meanings.

The Living Labs sought to understand practices in relation to all elements, with an emphasis on social norms and other meanings. According to Shove [7], normative notions of 'comfort, cleanliness and convenience' contribute directly to the entrenchment of certain practices compared to others. Mirroring this view, we treat norms as socially negotiated, culturally rooted and materially sustained, whereby combinations of both explicit and implicit rules of conduct form an integral part of practices and incur some form of social disapproval or sanction in cases of transgression. This distinguishes norms from other meaningful codes of conduct that also shape how people interact with others (and with the environment) but whose adoption remains more or less voluntary. Our use of the term 'social norms' is thus distinct from that in cognitive and behavioral approaches, that locate the effect of social norms at the level of individuals.

How energy use in the home is understood in relation to energy savings also connects with dominant meanings. 'Energy efficiency' has been normalized as a desirable energy policy goal, yet a sole focus on efficiency has been shown to fall short of achieving real reductions in energy use [18,29]. The notion of 'sufficiency' is emerging in both research and policy, with meanings that are diverse and varied [30], as we will discuss later. If and how people engage in 'sufficiency' practices emerged as an interesting focal point during our analysis of the Living Lab data.

A growing body of literature seeks to understand social change by understanding practices. Rather than changing individuals or units of technology, practice-centered studies offer a more comprehensive understanding of social life and its transformation. Some of these reflections focus on time use, life events and spatial arrangements to understand how practices can change or stabilize, while others emphasize the repeated performance of practices as a source of stability [13,31–35]. Three types of changes in practices can be distinguished [10]: 1) re-crafting practices, 2) substituting practices and 3) changing how practices interlock. These forms of practice-centered change have been experimented with through various change initiatives, for example reducing washing among a group of students in Australia, by

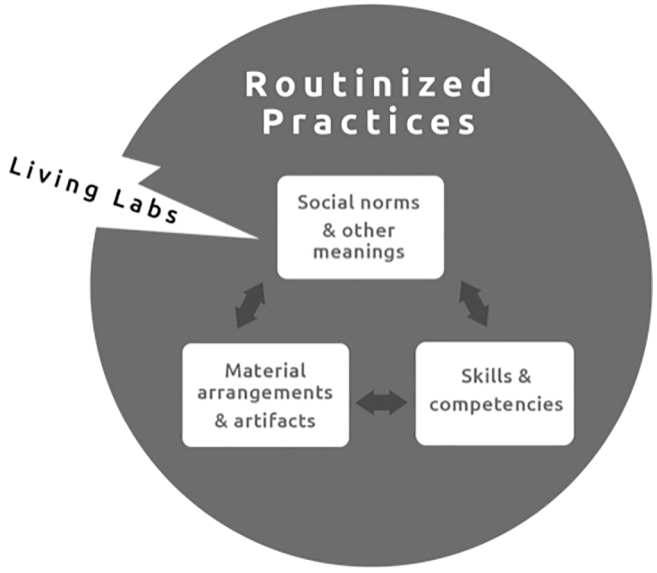

Fig. 1. Living Labs as a method for interrupting routinized practices (The conceptualization of social practices builds on [27] Shove, E., M. Pantzar, and M. Watson, *The Dynamics of Social Practice: Everyday Life and how it Changes*. 2012, London, UK: Sage publications.)

encouraging the wearing of the same pair of jeans over several weeks [36]; initiatives aimed at contesting social norms in practices in different consumption domains in Switzerland [37]; a practice-based Living Lab towards disrupting household food habits in Ireland [38]; and engaging with social practices to discuss future imaginaries of energy consumption towards envisioning change, also in Australia [39]. Large-scale change initiatives rooted in practice thinking nevertheless remain scarce.

As part of this literature, the role of social practice theory in informing the design of change initiatives has become an emerging line of inquiry [40–42], contrasting with behavioral approaches in sustainable design [43]. Practice-centered design can apply to workshops, where changes in practices are discussed and imagined, or to experiments that seek to recraft or substitute practices in everyday life, through the introduction of 'trigger products' for example [44]. Common to some approaches is a stage where people come together to reflect on social practices, by mapping the network of social and material elements that make up a practice [42], to then come up with 'change points' to reconfigure one un-sustainable practice into another [40]. Those engaged in such processes range from groups made up of researchers and practitioners, to groups that directly involve everyday people in the design process. Importantly, reflections on practice-centered design frequently stress that designers are not 'syringes that can inject desired change into some insulated terrain' [42], and that diverse understandings of the world are not only accepted but encouraged.

The Living Lab approach builds on practice-centered design in two ways: first, Living Labs are a temporary space where different rules apply, moving beyond the design phase into that of experimentation in a real-life setting [45]. Routinized practices are thus interrupted for a given time, to encourage people's engagement in new ways of doing. Second, Living Labs are a process: rather than achieving a set outcome, collaboration between citizens, research teams, implementation partners and other stakeholders are privileged, towards collaborative and social learning. This starkly contrasts with approaches that seek to 'nudge' people to behave better, relying on liberal paternalism – or the assumption that some authority would know best how subordinates ought to behave. In energy studies, Living Labs have been used to experiment with living in zero emission homes [46] and with smart heating systems [47], or testing new ways of refurbishing historic city centers [48], among others, revealing novel dynamics between actors engaged in energy transitions [49].

The ENERGISE Living Lab approach was designed to serve as a 'rupture' to habits and routines that involved an initial deliberation phase, where researchers and household members engaged in discussions about elements of practices, how they inter-connect, and particularly the social norms and meanings holding certain 'ways of doing' together (Fig. 1). It thus directed attention to practice configurations that were then top of mind when people engaged in the challenges, trying out new ways of doing that could become prefigurative of future, stabilized changes in habits and routines. The notion of a rupture relates to other concepts used by practice-inspired scholars, from 'breaking the bad habits' of capitalist systems [21], to forecasting for 'disruptions' [39], recognizing 'fractures' at different scales [31], or uncovering 'cracks' in the stability of social norms, through emotions [37].

3. Initiating change through a practice-based Living Lab approach

Drawing on a review of sustainable energy consumption initiatives in Europe [5,6] as well as a practice-based conceptual framework[4], the ENERGISE consortium designed two types of Living Labs. For the first, households were recruited and engaged with separately, with little to no interaction between them (ELL1). The second type involved recruiting participants and engaging with them collectively (ELL2)[5], so as to ascertain whether and in what way collective forms of engagement and social learning could further support social change. Both ELLs involved two challenges: to reduce indoor temperature to a maximum of 18 °C ('heating challenge') and halve the number of weekly laundry cycles relative to a baseline ('laundry challenge'). Their implementation took place in late 2018 across eight European countries involving 306 households, with the study continuing in 2019 with a follow-up survey, from 2 to 4 months after the end of the challenge period.[6] Quantitative and qualitative data were collected before, during, and after the challenges (see Annex 1 for an overview). Overall, the methodological approach featured distinct stages (Fig. 2), described below[7].

[4] See http://energise-project.eu/deliverables

[5] Comparing the two approaches is beyond the scope of this paper: a further publication is being prepared.

[6] Participating countries include Denmark, Finland, Germany, Hungary, Ireland, Switzerland, the Netherlands and the United Kingdom.

[7] A further stage, not detailed in this paper, involved translating findings into policy-relevant results; the policy-centered work package ran in parallel throughout the project, with reports available online: http://www.energise-project.eu/policy_briefs.

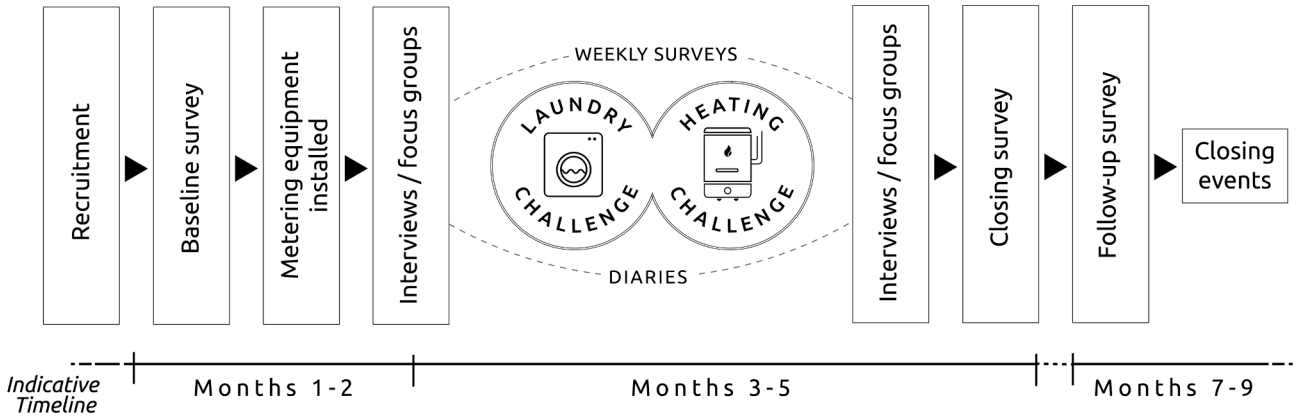

Fig. 2. Timeline and process of the practice-centered Living Lab design.

3.1. Stage 1: Research design informed by social practices and Living Lab approaches

The ELLs were designed in a dialogue between the research team, implementation partners with expertise in community and energy issues in each location (for example, local community energy associations), along with members of the ENERGISE Expert Panel (made up of utility companies, academics, experts and policy-makers at the national level, who followed the project from start to end). A decision was made to select laundry and heating for different reasons. Space heating is a largely taken-for-granted domain that is responsible for the largest share of overall household energy use in Europe. What renders thermal comfort complex is that it involves various dimensions, from outdoor climate, to built environments (e.g. building envelope efficiency, the presence of large south-facing windows), or the habits of neighbors (e.g. heat transfer from adjoining apartments). Laundry, on the other hand, has a relatively smaller share of direct household energy use but is significant for understanding change in relation to regular and routinized practices, as well as water and detergent usage. The absolute target for heating was a result of reflections around the great variety in indoor temperatures in Europe, but a general consensus among partners that 18 °C would put most people slightly outside of their comfort zone. A relative target for laundry was established so as to recognize variability in laundry loads in relation to household size. Previous practice-centered work on laundry [7,37,50–53] and thermal comfort [22,24,54–56] provided an important research base that informed the design of the Living Labs more generally, and the setting of targets in particular.

Purposeful sampling aimed at diversity in sociodemographic parameters was deployed and led to rich data that reflects wider trends concerning the two target practices – without aiming for statistical representativeness. Sampling criteria included the possibility to change temperatures in the home and access to a private washing machine (whether privately owned, or shared, in the building; to allow for electricity metering). Partner countries ensured a 'sufficiently diverse' sample of households, a subjective judgement call each partner made given their knowledge of the study region and the initial pool of participants attracted to the project. Diverse recruitment strategies helped to increase sample heterogeneity (i.e., on-street campaigns, local advertising, social media, snowballing, etc.). Each partner previewed their pool of potential participants and selected the final sample with the aim to include less represented groups, such as single-parent households or unemployed households, for example. A summary of the sociodemographics for all ELL participants and building types (age of building, rental or ownership) is provided in Annex 2. In signing up for the Living Labs, participating households did not know how the initiative would play out nor the level of engagement required, as they were not informed of the challenges beforehand. They were invited to join an initiative on energy usage in the home and in relation to everyday practices that would run for several months – from the first point of contact to the follow-up interview.

Each challenge took place over a four-week period, with an overlap of one week wherein the two challenges ran simultaneously. Baseline and exit surveys captured a 'before and after' picture of laundry and heating routines. Households were asked to complete a laundry diary and weekly surveys, as well as collect data through energy meters (on washing machines and, in some cases, dryers), thermometers and thermo-loggers. Households received two ENERGISE Challenge Kits that corresponded to each consumption domain, to be opened at the start of each challenge, providing materials and tips to support the learning experience. For example, for laundry, eco-friendly stain removers were included, along with an apron, to question regular washing routines and help keep clothes 'clean' for longer. For heating, warm drinks and socks were provided, supporting the idea of warming people rather than spaces. Similar to Kuijer and Jong [44], these 'trigger products' were seen as starting points for discussions between household members. Achieving the target was de-emphasized; the main aim of the challenge was the social learning process. The emphasis was shifted from the need for individuals to learn, to learning through participation in a collective endeavor and with a focus on social practices [57].

3.2. Stage 2: Living Lab implementation and follow-up research in eight countries

A deliberation phase at the start of the ELL was designed to support a 'rupture' in social practices, encouraging participants to reflect on their routinized practices by considering different 'elements of practices' and their inter-relations, but also social dynamics, or who does what in the home – demonstrating how people can talk about their practices [58]. In-depth interviews took place for ELL1, and focus group discussions for ELL2. Following Browne [59], the focus group discussions were particularly useful towards people recognizing shared or divergent conventions. An emphasis was placed on making visible the often-implicit social norms and meanings tied up with heating and laundry practices. As such, two normative dimensions were identified for each domain by the *trans*-disciplinary team and building on the literature: for laundry, meanings around intensive cleanliness were challenged, such as the sparkling white shirts often displayed as an ideal in detergent advertisements [60]. The time intensity of doing laundry was highlighted, beyond the time of the wash cycle to include sorting, hanging, or folding clothes, and in relation to the gendered allocation of responsibility for these chores. For heating, expectations around indoor comfort as largely detached from seasons were discussed, exemplified by the wearing of a t-shirt year-round for some; second, the notion that we tend to heat spaces

in an unlimited manner, rather than heat solely the people in those spaces, or adapt temperatures to different people and activities in spaces (as developed in [44]).

Because these representations of social norms and meanings were not easy to discuss, we turned to photo-elicitation methods to start a dialogue with participants, with different visuals used to represent these meanings (similar to [37]). Exit interviews and focus group discussions were organized shortly after the end of the ELLs, with a follow-up survey administered two to four months after the end of the challenges. Following Hitchings [58], this introduced an element of comparison over time – participants were able to reflect on changes in their everyday lives, from before the challenges to after. Again, learning about how and in what way changes took place was emphasized, rather than achieving an aim.

3.3. Stage 3: Comparative analysis of Living Lab results

This cross-national qualitative study required streamlining data collection across the eight countries, facilitated through a conceptual framework that served as the common thread for Living Lab design and comparative analysis. All national research teams provided short summaries of responses and direct citations, using an interview and focus group reporting template. We also transcribed (and translated into English where applicable) two interviews from each country, based on a selective sample of households that represented 'sufficiency' measures, based on reflections on how our understanding of this notion evolved over the course of the project – as discussed below.

The qualitative data led to in-depth analyses both within and across the 306 participating households. To be able to compare 'insider' and 'outsider' perspectives, exchanges between national research teams were facilitated through: a consortium workshop in February 2019 where team members read and discussed each other's data sets, identifying similarities and differences in the findings; the preparation of eight country reports provided by each national team[8]; and the comparative analysis of quantitative and qualitative data sets and country reports. All qualitative data used a same coding scheme, in NVivo 12. For analyzing quantitative data, a joint survey platform allowed all teams to collect data, which was then merged into Excel files. Data sets from four sets of surveys were then combined and analyzed with SPSS version 25.0. Closing events were hosted in each location with participating households, to share results from each Living Lab, as well as across countries. Here again, an emphasis was placed on what we – the household members, research team and implementation partners – had learned in the process.

4. Empirical results: How social practice-informed Living Labs support change

In this section, we first consider laundry then heating to discuss how associated practices were 'recrafted' through changing elements of practices (as conceptualized in Fig. 1). We then summarize results in relation to trends towards reductions in energy usage. The results are typical observations from among the 306 participating households from eight countries. We do not present findings that are representative of an entire country, but nonetheless refer to commonalities between certain households in some countries when appropriate.

4.1. Recrafting laundry-related practices towards washing less

Setting a target of 'halving the number of wash cycles per week' and engaging households in a deliberation around laundry practices encouraged reflexivity around habitual and routinized ways of doing laundry. Prior to the challenge, households stated that they used different approaches to decide on wash frequency: for some, the fullness of a laundry basket would prompt the need to wash; for others, a pre-established weekly schedule determined when clothes should be washed. For those working at home full time, there was less of a need to have a fixed routine; for larger families, care and professional responsibilities made it more necessary to set a routine. Different types of clothing were washed with varying frequency, with undergarments, socks and other clothing items with close proximity to the body requiring more regular washing for most participants. Some Danish and Hungarian households reported washing newly purchased clothes before wearing them for the first time. Changing seasons might also induce more wash cycles, with heavier items such as blankets or curtains getting washed after being moved out of storage, as was the case among some households in Hungary.

In coming to terms with washing less during the challenge period, most participants did not feel un-clean, particularly in relation to washing jeans, sweaters, and bedding less often. While 'whites should be white' was a common sentiment among some households (particularly in Denmark, Germany and Hungary), participants across all countries rejected the idea that washing could achieve the degree of whiteness promoted in laundry detergent advertisements. Some participants even associated these images with an excessive use of chemicals. Households across the countries developed new ways to extend the use of clothes, by airing them out, better organizing their existing 'in between' piles to avoid putting 'used' clothes back into closets, or simply wearing clothes for longer. Doing fuller loads was common across the countries, with the Challenge Kit laundry booklet providing tips on how to avoid under- or over-loading machines, how to air out clothing and prevent stains, or brush off dirt from outer clothing. There was a discernible increase in these tactics across all households. A Danish participant described how a new skill led to a shift in meaning around cleanliness:

"And then we've also talked about whether others perhaps think we are a little dirty, because we are trying to wear the same clothes for a longer time, but I haven't felt dirty at all, or smelly. Not after it's been airing on a clothes line". (DK245)

Householders who developed new skills found that they washed clothes more often by hand, removed stains, used an apron more often, or rinsed particular clothing parts – collars of the shirts, for example – instead of washing the entire item. Use of the Challenge Kit aprons to protect clothing was taken up by some households. Yet others reported that the use of aprons was a pre-established habit. Natural stain removers provided in the kits were also experimented with in different countries.

The challenge also introduced a more sensorial approach to 'doing the laundry'. Based on the survey data, about half of the participants used the length of wear as the main criterion to assess the cleanliness of a piece of clothing before the challenge. This dropped to approximately one quarter of participants at the end of the challenge. In contrast, only a quarter of all participants relied on smell before the challenge, which became the main criterion for about half of the participants at the end of the challenge. This increase in the use of smell rather than length of wear suggests the partial replacement of 'automatic' or more mechanical decision-making with a more sensorial and critical approach to judging when an item needs washing. These trends are generally confirmed in the follow-up survey. Continuing with the sensorial dimensions of practices, one main obstacle to reducing the number of wash cycles was the visual and emotional response to the piling up of dirty clothes around the house, which triggered feelings of being untidy or living in a messy home, a disconcerting feeling for some[9].

[8] Supplementary materials are available online at: http://www.energise-project.eu/livinglab_country_reports.

[9] For a more in-depth discussion of the Swiss and Finnish cases, see 26. Godin, L., S. Laakso, and M. Sahakian, *Doing laundry in consumption corridors: wellbeing and everyday life.* Sustainability: Science, Practice and Policy, 2020. **16** (1): p. 99–113.

Experimentation with new ways of doing encouraged some households to go beyond the 'tips' suggested in the Challenge Kits, and develop novel skills and tactics. For example, some Danish participants decided to wear clothes within the same color range for a longer period of time, to gather a full load without having to mix colors. Taking a shower while washing undergarments was another novel strategy devised by a Danish participant. A UK household resorted to putting ties in the freezer to remove smell. Parents in several countries declared giving back clothes to children 'clean and washed' without actually washing them. In addition to using existing spaces such as racks, chairs and hangers, some participants created new spaces in their closets or drawers to store slightly worn clothing. The challenge also led to reflections on what clothes to buy in the first place, whether new or second-hand, with households privileging 'better quality' clothes, understood as non-synthetic and thus less likely to capture odors.

Most participants agreed that it is important to have clean clothes for work and social occasions, such as having guests over or visiting others. Wearing the same clothes to the workplace for more than one day in a row was considered to be unacceptable for many, with workplace standards playing an important role on clothing usage and laundry, as studied elsewhere [51,56]. In Denmark, certain households organized a rotation system for used work clothes so that they could be worn more frequently but never twice in a row. Households also differed in their views regarding the necessity for children to wear clean clothes. For example, some households insisted on providing clean clothes for small children attending school or a social occasion. Yet others claimed that they are not fussy, that their children could wear the same clothes all the time, or that they provide play clothes. Having special clothes for specific activities such as gardening or doing sports was one way to facilitate wearing clothes repeatedly without washing. Certain households also explained that they would change into home clothes, to keep work clothes in a better condition for re-use.

Because of our initial deliberations on the time it takes to do the laundry, beyond the wash cycle, to include all laundry-related tasks, such as sorting clothes, hanging to dry, ironing, folding, or putting clothes away, participating in the challenge rendered these tasks and associated time intensity more visible. At the start of the challenge, households across all eight participating countries had not given much thought to this, beyond the time of the cycle itself. After the challenge, a majority of households felt that laundry was a chore that took up too much of their time. In Hungary, a woman explained how washing every other weekend has freed up leisure time: "As I do not have to wash every weekend, I have a free weekend (…). Completely free." (HU100).

As a material arrangement, washing machines and how laundry is organized in the home could become significant obstacles to practice change. Many households had the habit of using only a few key settings or expressed confusion about the different programs. A large number of participants did not seem to understand why the 'eco button' might be more efficient, given that it results in a longer wash cycle; thus, equating efficiency with time savings (as opposed to water and energy savings). Some households experimented more with their machines, testing different settings and gauging their energy use with meters provided, or familiarizing themselves with the machine manual. Others experimented with cold washing and other settings that they had not used before. Material arrangements that hindered the reduction of laundry cycles included limited space available for storing slightly worn clothing, storing dirty laundry, or drying laundry. Many participants discussed how they found it difficult to wait for laundry baskets to be fuller so that they could put on a larger load. To solve this problem, some declared using a laundry basket that holds exactly as many clothes as a full load in their machine, while others purchased more laundry baskets to organize their laundry by color, or by bedroom. There was some concern among a small number of participants about having 'not enough' clothes – particularly undergarments – to last until the next full-load laundry cycle. Buying new things and washing by hand represent possible spillover effects of this challenge.

4.2. Recrafting heating-related practices towards reduced indoor temperatures

Prior to the heating challenge, households across the eight countries were generally satisfied with their heating systems and temperature settings – which, when combined with other factors such as humidity levels, sun exposure, or drafts, contribute to thermal (dis)comfort. A more in-depth discussion during the deliberating phase revealed that household members within the same family would not always agree on an ideal indoor temperature setting; meanings of comfort varied greatly. The challenge represented a time–space configuration that incited many people to reflect on the notion of thermal comfort and associated settings, which had heretofore been taken for granted. A person's threshold for comfort also changed over the course of the challenge period, as bodies adapted. People noticed these changes for themselves and in relation to others, suggesting that the challenge created an opportunity for increased reflexivity in relation to comfort as a relative and subjective notion. The digital thermometer proved to be a useful device, as a tool directly related to the goal of reducing indoor temperatures to 18 °C – which, if achieved, was experienced as too low for many. The thermometers allowed people to relate their feelings of (dis)comfort to temperature measurements, but also to recognize that the same temperature can be experienced differently, by different people, and in relation to varying activities. The diversity of how practices play out was a conversation that was started in the deliberation phase, but continued to work its way into discussions about the challenges between members of the same household – and, in some instances, visiting guests – as well as between households who participated in the focus groups.

Reducing indoor temperatures led people to experiment with different ways to keep their bodies warm in colder spaces, by wearing additional layers – what Wallenborn and Wilhite [61] have called 'skins', both in relation to layers on people and in spaces. These layers could include clothing, such as warm pyjamas, socks, slippers, winter duvets or blankets to heat people, or blinds, curtains, rugs or doors to create warmer, bounded spaces within the home – to trap heat or deter the flow of cold air. These efforts were not necessarily new for many households, but intensified during the challenge period. Some participants purchased new material elements for keeping warm, such as warmer pyjamas, rugs for the bathroom, or woolen socks (which were also part of the Challenge Kit). Some animals got extra help from their owners for keeping warm, for example a gecko got a heating mat in a Finnish household – building on other studies of pets as energy consumers [39]. The notion of warming people (and pets), rather than spaces – a theme explicitly discussed in the deliberation phase – was central to reflections and ways of doing during the challenge.

Activities also helped people stay warm – such as doing physical exercise, or playing games together (a board game provided in the heating Challenge Kit, to 'trigger' this idea). Taking warm baths and showers may have been one of the spillover effects of the challenge; at least a few Danish participants admitted to staying a bit longer in hot showers to feel warm. Despite saunas being common in Finland, only a handful of people mentioned that they occasionally went to the sauna to feel warmer. In the UK, a participant admitted to now appreciating the use of hot water bottles for staying warm. Although not discussed in the Challenge Kit tips, several households across all eight countries turned to wood stoves or fireplaces as a way to manage heat in their homes. Generating heat in this way was a means to gain control over the diffusion of heat and engage in the actual practice of making warmth, as discussed in [17]. Some households noticed how direct sunlight influences indoor temperatures, and re-organized room functionality as a result, or refrained from certain activities in the colder rooms. Participants in countries where room-based thermostats were more readily available would simply turn down the heat in rooms that were less used. Certain households recognized that their heating needs varied during the day, in response to different activities. As a UK participant put it, "[i]f you're feeling cold purely because you've been too sedentary then the

easiest way to fix that is to move" (UK11). For those who worked from home and remained relatively immobile during the day, the 18 °C target was too low. The same applied to elderly people with reduced mobility.

One of the difficulties with reducing indoor temperatures are the meanings tied up with being comfortable indoors. For example, coming home from work was associated with 'undressing' or 'dressing down' for some, as a way to become more comfortable and relaxed. Some participants enjoyed the experience of walking barefoot at home, or sleeping in the nude, associating them with comfort. For others and conversely, bundling up with a warm sweater and woolen socks was also about feeling cozy: a Finnish participant used a Danish word to describe dressing warmly as creating a "*hygge* situation (…) in nice contrast to the working me…" (FI32). There was also a general sense among many households that people should have the right to a warm home, associated with a sense of entitlement, as discussed elsewhere [62]. Conversely, new meanings emerged around the experience of living in a colder domestic environment. For example, some participants stated that they experienced a higher quality of sleep after turning down the heating in the bedroom. Some parents also discovered that their children sleep better and are less prone to getting ill in colder rooms. These experiences led to new associations between good sleep, good health, and lower temperature settings.

Negotiating the thermal comfort with household members was one of the obstacles to lowering room temperatures. In multi-person households, the disruption of the previously negotiated status quo with regard to temperature settings had the potential to lead to conflict, with those preferring lower temperatures more open to the challenge. The thermal comfort of small children and elderly people in the household were a particular concern. For some parents, there was a strong sense that children should not have to feel cold. In several countries, there was a tendency to turn up the heat for visiting grandchildren, younger relatives or elderly people. In some cases, socks and blankets were distributed to guests. Living in a cooler home meant that some participants then experienced other spaces – such as the workplace, or friends' homes – as overheated [17].

When faced with the heating challenge, some participants found it difficult to achieve the 18 °C target for technical reasons – and opening windows to drive down temperatures was not part of the plan, as the challenge was designed to encourage people to reduce as much as possible, not to achieve the exact target temperature *per se*. Interestingly, these issues emerged across all of the eight participating countries. Another obstacle was the adaptability of indoor temperature settings, and people's inability to regulate such settings in meaningful ways. For example, many apartments in Switzerland have complex hydraulic floor heating systems, with delays between valve changes and experienced temperature change[10]. In total, 37% of households across the eight ELL countries could regulate heating through thermostatic valves or other devices specific to rooms, 27% could adjust heat demand only for the home as a whole, and 31% had both possibilities (individual rooms and entire dwelling/apartment) (Fig. 3). Interestingly, participant households with heating systems that can only be adjusted room-by-room reported greater reductions in their indoor temperature in the living area and bedroom than households with heating regulation possible only for the entire home (an average 1.3 °C reduction, compared to 0.5 °C). Allowing for finer regulation makes it easier to modulate temperature between rooms in relation to different activities (to lower temperatures in bedrooms only, for instance).

For some participants, the challenge allowed them to develop new skills and competencies in relation to socio-technical heat provisioning systems, such as learning how the boiler works. In the UK, some participants who had been dissatisfied with their heating systems used the challenge period as an opportunity to look into the installation of loft insulation in one case, and draft protection for doors and windows, in another. Some households declared an interest in retrofitting their homes or investing in alternative energy solutions, due to experiencing the challenge.

4.3. Summary results: Supporting practice-centered change towards reduced energy use

Both in terms of reported indoor temperatures and laundry cycles, reductions can be observed across the eight countries over the course of the challenge periods and, in some cases, during a follow-up survey administered two to four months after (see Figs. 4, 5 and 6 below).

Doing laundry and keeping warm are very different types of practices, and as such are resistant to change in different ways. Doing laundry involves a series of sequential actions, such as sorting, washing and drying clothes. Disrupting the practice means changing a part of that sequence: for example, by reconsidering (sometimes shared) meanings around what 'clean or dirty' is, but also by acquiring new or re-covering past competencies and skills for airing out clothes or removing stains. Material arrangements also played a role in reducing the number of laundry cycles, for example by organizing 'used' clothes in a certain way, or finding new ways to keep dirty laundry out of sight. Keeping warm is more difficult to associate with a distinct practice, given that heating a home generally does not involve a series of actions – such as chopping wood, or keeping the fire burning. It could involve turning down a thermostat or a hydraulic valve for floor heating, but can also be a practice delegated to building managers, preset boiler systems, or other actors and objects in heating systems. Reducing indoor temperature settings leads to other actions that could be described as more cumulative rather than sequential, such as putting on a blanket when sitting on the sofa, while wearing warm pyjamas or slippers, or having a hot cup of tea. The heating challenge revealed the significance of what activities play out in what spaces, in relation to how bodies are kept warm – a practice-centered observation.

What 'doing laundry' and 'keeping warm' share is the variability in how these practices are carried out by people, across all countries and even within the same household – and, therefore, such differences need to be a key consideration in a practice-centered intervention design process. For example, we found variations in how people decide what needs to be washed with length of wear, visual appearance and smell emerging as key factors. Interestingly, sensorial approaches (e.g., checking for stains, smelling) became increasingly important in all countries as the laundry challenge progressed. This suggests that a 'rupture' in habits and routines might lead to attention shifted away from cognitive capabilities to more sensorial and emotive ones, as people engage in deep reflexivity. There were also differences in how people understood indoor comfort, which varied among members of the same household, but could also differ between body parts for the same person – feeling warm in the body, but having cold hands, for example. Efforts to change ways of doing also reveal social dynamics, in relation to different ways of doing for welcoming guests or in the world of work. We also found that socially negotiated norms relate to different life stages: reduced laundry was more difficult for some families with small children, but was more important for gaining time, for example; and heating the home was more important for elderly people, most likely due to their reduced mobility.

Both for 'keeping warm' and 'doing laundry', certain households used the challenge as a time to familiarize themselves (again) with their heating systems and washing machine programs, thus breaking long-standing habits. The technical devices provided as part of the challenge were useful, in that people were able to read energy meters to compare wash programs, or relate digital thermometer settings to feelings of (dis) comfort. Critically, we suggest that such tools can be effective in so far as they serve a goal that people have set for themselves – such as reducing

[10] For a more detailed description of the Swiss case and the indoor climate as cultural artifact, see: 17. Sahakian, M., H. Rau, and G. Wallenborn, *Making 'sustainable consumption' matter: the indoor microclimate as contested cultural artifact.* Cultural Sociology, 2020. **14**(4).

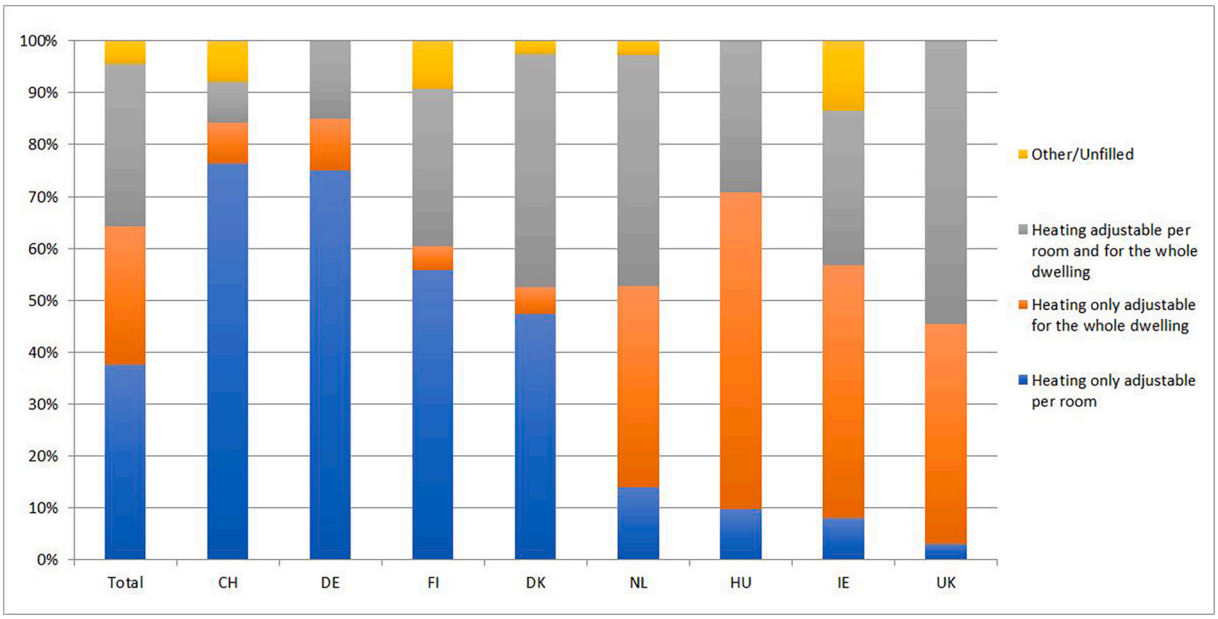

Fig. 3. The ability to adjust heating systems by country.

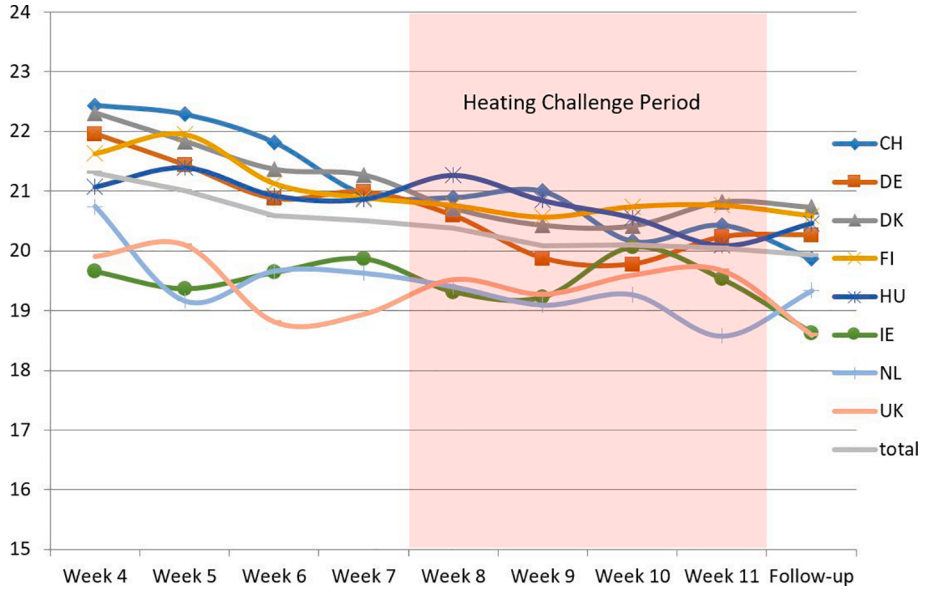

Fig. 4. Mean Reported living room temperatures before, during and three months after the challenge for all participating countries.

laundry loads, or decreasing indoor temperatures – and are not necessarily useful in and by themselves. We also found that people are excellent sensors, with bodies and senses acting as feedback mechanisms. Both challenges made people become more reflective about their experiences and practices – recognizing temperature changes and drafts, and learning to distinguish dirty from clean by sight and smell, for example.

The spillover effects of the challenge were also considered, through surveys and qualitative methods. Some people made new purchases as a way to manage the challenge periods, or engaged in materially and energy-intensive activities, such as taking warmer baths or showers – but these instances were not common. In addition, more climate-conscious spillover effects also occurred. The challenges also led to reduced consumption in other domains, most often in relation to other appliances, such as the reduced use of the dishwasher, or the turning off of appliances and lights when not in use. Water consumption was regularly mentioned, with participants being more aware of how much water they used. Participants in several countries also assessed their shopping habits, being more careful about what clothes to buy to reduce the need to do laundry, or trying to reduce food packaging. Some participants claimed that they would have liked to try out different challenges, like giving up a car for a week or trying a vegan diet. A large number of participants stated at the end of the project that they shared their experiences with friends and relatives, another positive spillover.

Two exit interviews per country were selectively transcribed, based on how and in what way the participants related to the notion of 'sufficiency' – as assessed by the research team. Initial ideas at the start of the project regarding sufficiency and its links with the performance of routine practices were subsequently expanded and refined. We recognized, critically, at the onset of the project that 'efficiency' was more

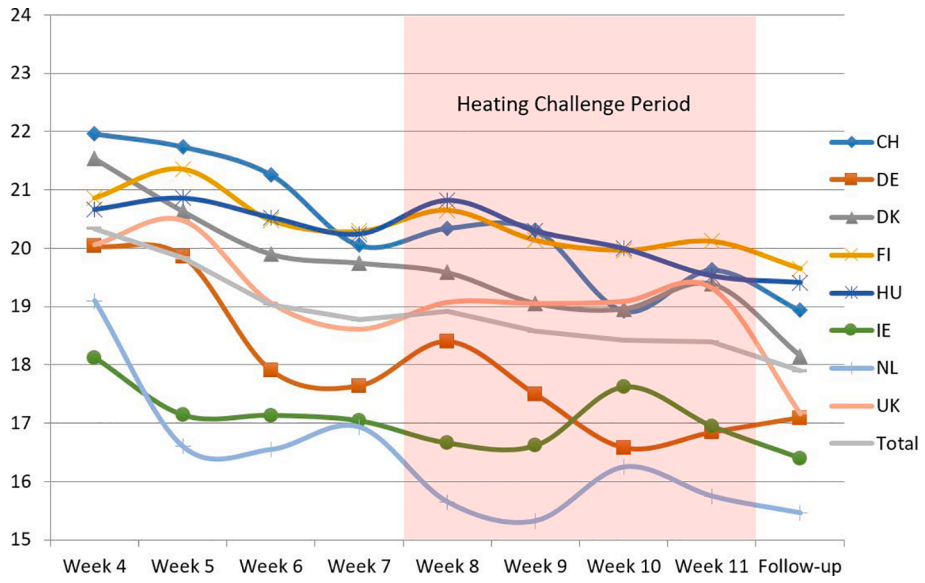

Fig. 5. Mean reported bedroom temperatures before, during and three months after the challenge for all participating countries.

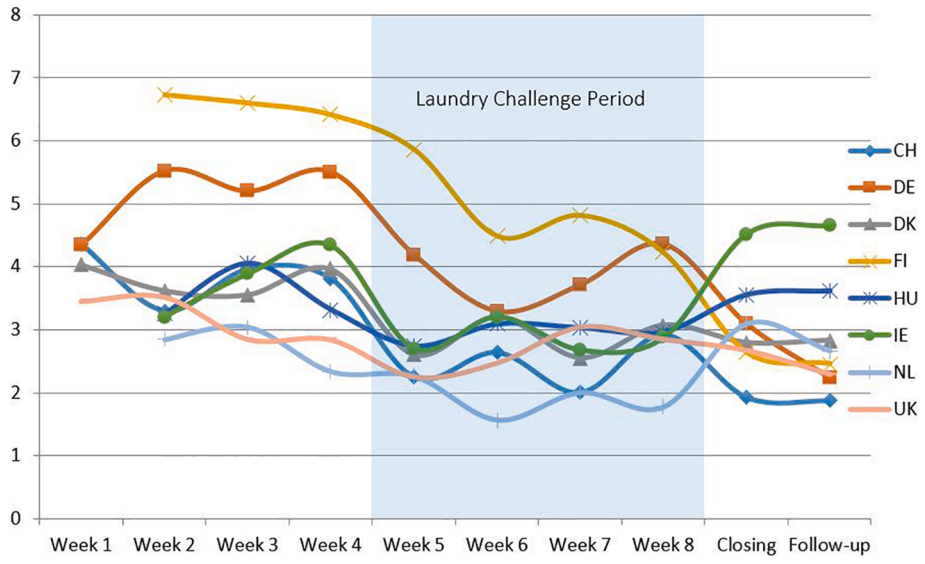

Fig. 6. Mean reported number of weekly laundry cycles before, during, immediately after and three months after the challenge for all participating countries.

established as the right way to go about handling energy demand. By the end, we came to see new meanings emerge from the data in how people came to relate to limits. Specifically, people discussed how the challenge period introduced limits that led to new ways of doing, but also a realization that such limits could result in positive feelings and wellbeing, from sleeping better at night, to having more time and fewer chores, or even the positive feeling of being a part of a European-wide challenge. In some cases, limits in these two domains – heating and laundry – led to reflections on how limits could be applied to other consumption domains. We concur with Kallis [63] that limits need not be imposed from above, and that maximizing efficiency can be counterproductive. In other words, the key question is not how much we can consume before hitting a limit but rather how to consume less, because it might be best. The challenge led some people to consider how much of what is enough, making limits meaningful and associating them with positive outcomes – towards a definition of sufficiency that combines limits with wellbeing and a sense of 'enoughness' [64].

Table 1
Average changes in reported temperatures and wash cycles during and after ELLs.

Change in temperatures		Change in weekly wash cycles
Living room	**Bedroom**	**All**
From 21.2 °C to 20.1 °C *1° less* Follow-up:19.8 °C	From 20 °C to 18.5 °C *1.5° less* Follow-up:17.7 °C	From 4.1 cycles to 3.1 cycles *1 cycle less* Follow-up: 2.9 cycles

(Data source: weekly surveys; averages taken before challenges, and at the end of challenges; starting points based on the baseline seven weeks preceding the challenge; follow-up data from 2 to 4 months after the end of the challenge, for all participating countries[a]).

[a] As these numbers are based on averages, we do not analyze here the differences between countries – as illustrated in Figs. 4-6; this would merit further analysis.

5. Discussion and conclusion: A practice-based approach to reducing energy use

As a practice-based change initiative focused on reducing household energy use in relation to 'doing laundry' and 'keeping warm', the ENERGISE Living Lab (ELL) results demonstrate that reductions are possible when routinized practices are disrupted through experimentation. The deliberation phase with households was an important first step in the practice-centered design, in that it engaged participants in understanding how practices play out, involving their constituent and inter-related elements, and in making more explicit the social norms tied up with certain ways of doing, which are nonetheless diverse and varied. The Living Lab approach guided the process of change, with an emphasis placed on learning together, rather than competing or winning. Participants learned in 'communities of practice' [57] that formed between household members, through exchanges with the research teams and local practitioners, and, in the case of the collective-approach in ELL2, among Living Lab participants.

The change initiatives encouraged people to reflect critically on their routinized practices, and work collaboratively to set targets, challenge habitual and routinized ways of doing, and share experiences with others. All households knew they were part of a collective effort that involved more than 300 households across Europe, and this sense of virtual community fostered positive emotions. While inviting people to leave their comfort zone created situations that were not always pleasant, and that occasionally caused tensions among household members, participants across the eight countries were generally satisfied with their experience. For many participants, the Living Lab itself – as a space–time configuration, supported by the challenge kits – acted as a 'trigger', with the initial deliberation phase as a first and necessary step towards social change.

To summarize the findings, average changes for reported temperature settings and wash cycles are reported: at least 1-degree change is possible in living rooms, and 1.5°in bedrooms; and at least 1 less laundry cycle is possible per week, for all households across eight countries (Table 1). These changes – which relate to varying energy savings, depending on the different energy sources available across the eight countries – do not require costly technical interventions, but rather time and resources for engaging and deliberating with households. How these changes might be maintained over time remains to be studied, as our follow-up data was limited to a survey. We posit that participants were able to incorporate the limits set in the challenges, and in some cases experience reductions in energy usage positively.

The project was also an experiment in practice-centered design on a large scale, and as such it has limitations. The question of recruitment is a recurring one, regarding diversity but also the necessity to keep up participants' interest for a period of six months; it is plausible to assume that people already interested in energy questions are more likely to sign up for and stay in such initiatives. By recruiting people in communities of place, we were able in some instances to involve people who would not have signed up for the challenges individually. The collection of data was also a challenge, particularly towards comparative qualitative analysis; here, we had to balance the need for simplification with the desire for rich data. Finally, questions of scalability and replicability are important considerations for designing future projects. Engaging media partners in the co-design of Living Labs could be one way to reach a broader audience around not only project results, but also to amplify deliberations around social norms and the significance of social practices as loci for social change.

ENERGISE is, to our knowledge, the only large-scale experimentation based on a practice-centered understanding of change, and aimed at lowering domestic energy consumption by using habits and routines as an entry point for encouraging increased reflexivity. At the time of this writing, households around the world are experiencing drastic changes in light of the coronavirus pandemic. Habits and routines are being disrupted, reinterpreted, reorganized and renegotiated, albeit under constraint and in most cases involuntarily – revealing social justice issues. Through ENERGISE, we demonstrate that positive changes can also be experienced through voluntary forms of social learning and participatory engagement, while recognizing the complexity of everyday life and the diversity of ways in which people across Europe engage in social practices. Such changes may encourage people to discuss and reconsider ideas around sufficiency and 'limits', in particular when a reduction in energy use in the home coincides with experiences of enhanced well-being in everyday life, a ripe terrain for future study.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix 1. Quantitative and qualitative research data collected for the study

	N	Collection period	Type of data
Recruitment survey	306	June - September 2018	Basic socio-demographics, building characteristics, appliance ownership, engagement with energy
Baseline survey	292	August – October 2018	Detailed data on laundry and heating practices
Laundry diaries[a]	273	September – November 2018	Weekly laundering/drying cycles, who did the laundry, readings from electricity meters
Heating diaries[b]	273	September – November 2018	Weekly temperature readings from two or three rooms
Weekly surveys	285	September – November 2018	Weekly surveys asked about weekly changes in circumstances (e.g., heating turned on) and participants feelings during the challenge
Closing survey	264	November 2018 – January 2019	Detailed data on laundry and heating practices, participants' self-reports on changes and communication during challenge
Follow-up survey	226	March 2019 - May 2019	Detailed data on laundry and heating practices, participants' self-reports on changes and communication during challenge, questions concerning spillover and rebound effects, overall satisfaction
Deliberation forms	167	September – October 2018	Individual and collective interviews were conducted before the challenge and have been summarized in identical forms.

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(*continued*)

	N	Collection period	Type of data
Exit forms	170	December 2018 – January 2019	Individual and collective interviews were conducted after the challenge and have been summarized in identical forms.
Transcripts	16	February – March 2019	Each country has provided 2 transcripts of exit interviews in English
Country reports	8	March – May 2019	Each team has summarized their findings of the ELL results in a common template.

a) Participants were equipped with energy meters and instructed to read these for the laundry diaries.
b) In addition to thermometers that participants were instructed to read, temperature loggers were placed in living rooms and self-reported temperatures were compared with temperature logger readings.

Appendix 2:. Sociodemographic data for all participants in ENERGISE Living Labs

Household size (n = 296)	1 member	2 members	3 members	4 members or more	
No.	39	89	40	128	
%	13%	30%	13%	43%	
Age of contact person (n = 260)	**34 or younger**	**35–44**	**45–54**	**55–65**	**66 or older**
No.	32	73	95	56	39
%	11%	25%	33%	19%	13%
Gender of contact person (n = 297)	Female	Male			
No.	177	120			
%	59%	41%			
Employment status of contact person (n = 252)	**Full-time employed or entrepreneurs**	**Part-time**	**Student/ Unemployed**	**Retired**	
No.	161	52	9	30	
%	64%	21%	4%	12%	
Educational level of contact person (n = 306)	**Tertiary**	**Secondary Phase/ Vocational**	**Primary**	**Other or unknown**	
No.	176	64	8	63	
%	57%	21%	3%	20%	
Type of dwelling (n = 298)	**Apartment**	**Terraced/semi-detached**	**Detached**	**Other**	
No.	74	93	125	6	
%	25%	31%	42%	2%	
Age of dwelling, built (n = 257)	**before 1960**	**1960 s-1970 s**	**1980 s-1990 s**	**After 2000**	
No.	59	64	53	91	
%	22%	24%	20%	34%	
Tenure (n = 257)	**Tenant**	**Owner**			
No.	52	205			
	20%	80%			

References

[1] T. Jackson, Prosperity Without Growth: Foundations for the Economy of Tomorow. Second ed. 2017, New York, USA, Oxon UK: Routledge.
[2] R. York, S.E. Bell, Energy transitions or additions?: Why a transition from fossil fuels requires more than the growth of renewable energy, Energy Res. Social Sci. 51 (2019) 40–43.
[3] E. Alfredsson, et al., Why achieving the Paris Agreement requires reduced overall consumption and production, Sustain. Sci., Pract. Policy 14 (1) (2018) 1–5.
[4] IPCC, Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty, V. Masson-Delmotte, P. Zhai, H.-O. Pörtner, D. Roberts, et al., Editor. 2018, World Meteorological Organization: Geneva, Switzerland. p. 32.
[5] C.L. Jensen, et al., Towards a practice-theoretical classification of sustainable energy consumption initiatives: Insights from social scientific energy research in 30 European countries, Energy Res. Social Sci. 45 (2018) 297–306.
[6] C.L. Jensen, et al., Achieving sustainability transitions in residential energy use across Europe: The importance of problem framings, Energy Policy 133 (2019).
[7] E. Shove, Comfort, Cleanliness and Convenience: The Social Organization of Normality. New Technologies / New Cultures Series, ed. D. Slater, 2003, Oxford, New York, Berg.
[8] E. Shove, M. Pantzar, Consumers, Producers and Practices: Understanding the invention and reinvention of Nordic walking, J. Consum. Cult. 5 (1) (2005) 43–64.
[9] A. Warde, Consumption and theories of practice, J. Consum. Cult. 5 (2) (2005) 131–153.
[10] N. Spurling, et al., Interventions in practice: re-framing policy approaches to consumer behaviour. 2013, Sustainable Practices Research Group Report. p. 56.
[11] M. Hand, E. Shove, Condensing Practices: Ways of living with a freezer, J. Consumer Cult. 7 (1) (2007) 79–104.
[12] R. Aro, 'A bigger living room required a bigger TV': Doing and negotiating necessity in well-to-do households, J. Consum. Cult. (2017) first published online.
[13] M. Sahakian, 'More, bigger,, better' household appliances: Contesting normativity in practices through emotions, J. Consum. Cult. (2019), https://doi.org/10.1177/1469540519889983 first published online.
[14] E. Heiskanen, et al., Designing Real-World Laboratories for the Reduction of Residential Energy Use Articulating Theories of Change, GAIA 27 (S1) (2018) 1–104.
[15] G. Goggins, F. Fahy, C.L. Jensen, Sustainable transitions in residential energy use: Characteristics and governance of urban-based initiatives across Europe, J. Cleaner Prod. 236 (2019), 117776.
[16] B.K. Sovacool, What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda, Energy Res. Social Sci. 1 (2014) 1–29.
[17] M. Sahakian, H. Rau, G. Wallenborn, Making 'sustainable consumption' matter: the indoor microclimate as contested cultural artifact, Cult. Sociol. 14 (4) (2020).
[18] H. Rau, P. Moran, R. Manton, J. Goggins, Changing energy cultures? Household energy use before and after a building energy efficiency retrofit, Sustain. Cit. Soc. 54 (101983) (2020).
[19] J. Mylan, D. Southerton, The Social Ordering of an Everyday Practice: The Case of Laundry, Sociology 52 (6) (2017) 1134–1151.
[20] J. Torriti, Understanding the timing of energy demand through time use data: Time of the day dependence of social practices, Energy Res. Social Sci. 25 (2017) 37–47.
[21] Wilhite, H., The political economy of low carbon transformation: breaking the habits of capitalism. 2016: Routledge studies in low carbon development.
[22] F. Bartiaux, et al., A practice–theory approach to homeowners' energy retrofits in four European areas, Build. Res. Informat. 42 (4) (2014) 525–538.
[23] E. Shove, G. Walker, What Is Energy For? Social Practice and Energy Demand, Theory, Cult. Soc. 31 (5) (2014) 41–58.
[24] K. Gram-Hanssen, Understanding change and continuity in residential energy consumption, J. Consum. Cult. 11 (1) (2011) 61–78.
[25] E. Shove, Beyond the ABC: climate change policy and theories of social change, Environ. Plann. A 42 (2010) 1273–1285.
[26] L. Godin, S. Laakso, M. Sahakian, Doing laundry in consumption corridors: wellbeing and everyday life, Sustain. Sci., Pract. Policy 16 (1) (2020) 99–113.
[27] E. Shove, M. Pantzar, M. Watson, The Dynamics of Social Practice: Everyday Life and how it Changes, Sage publications, London, UK, 2012.

[28] D. Southerton, Habits, routines and temporalities of consumption: From individual behaviours to the reproduction of everyday practices, Time Soc, 22 (3) (2013) 335–355.
[29] E. Shove, What is wrong with energy efficiency? Build. Res. Informat. 46 (7) (2018) 779–789.
[30] E. Toulouse, et al., *Energy sufficiency: how can research better help and inform policy-making?* in *ECEEE Summer Study Proceedings*, Hyères, France, 2019.
[31] K.J. O'Neill, A.K. Clear, A. Friday, M. Hazas, 'Fractures' in food practices: exploring transitions towards sustainable food, Agric. Hum. Values (2019) 225–239.
[32] S. Higginson, M. Thomson, T. Bhamra, "For the times they are a-changin": the impact of shifting energy-use practices in time and space, Local Environ. Int. J. Just. Sustain. 19 (5) (2014) 520–538.
[33] E. Shove, F. Trentmann, R. Wilk, eds. Time, Consumption and Everyday Life: Practice, Materiality and Culture. Cultures of Consumption Series, ed. F. Trentmann. 2009, Berg, Oxford, New York.
[34] M. Sahakian, H. Wilhite, Making practice theory practicable: towards more sustainable forms of consumption, J. Consum. Cult. 14 (1) (2014) 25–44.
[35] B. Heisserer, H. Rau, Capturing the consumption of distance? A practice-theoretical investigation of everyday travel, J. Consum. Cult. 17 (3) (2017) 579–599.
[36] T. Jack, Nobody was dirty: Intervening in inconspicuous consumption of laundry routines, J. Consumer Culture 13 (3) (2013) 406–421.
[37] M. Sahakian, B. Bertho, Exploring emotions and norms around Swiss household energy usage: when methods inform understandings of the social, Energy Res. Soc. Sci. 45 (2018) 81–90.
[38] L. Devaney, A. Davies, R, *Disrupting household food consumption through experimental HomeLabs: Outcomes, connections, contexts*, J. Consum. Culture 17 (3) (2017) 823–844.
[39] Y. Strengers, S. Pink, L. Nicholls, Smart energy futures and social practice imaginaries: Forecasting scenarios for pet care in Australian homes, Energy Res. Soc. Sci. 48 (2019) 108–115.
[40] C. Hoolohan, A.L. Browne, Design thinking for practice-based intervention: Co-producing the change points toolkit to unlock (un)sustainable practices, Des. Stud. 67 (2020) 102–132.
[41] K. Scott, C. Bakker, J. Quist, Designing change by living change, Des. Stud. 33 (3) (2012) 279–297.
[42] T. Vihalemm, M. Keller, M. Kiisel, From Interventions to Social Change: A Guide to Reshaping Everyday Practices, Ashgate publishing / Routledge, New York, NY, 2015.
[43] L. Kuijer, C. Bakker, Of chalk and cheese: behaviour change and practice theory in sustainable design, Int. J. Sustainable Eng. 8 (3) (2015) 219–230.
[44] L. Kuijer, A.d. Jong, *Identifying design opportunoties for reduced household resource consumption: Exploring practices of thermal comfort*. Forthcoming, J. Design Res. 10 (1/2) (2012) 67–85.
[45] Y. Voytenko, et al., Urban living labs for sustainability and low carbon cities in Europe: towards a research agenda, J. Cleaner Prod. 123 (2016) 45–54.
[46] M. Korsnes, T. Berker, R. Woods, Domestication, acceptance and zero emission ambitions: Insights from a mixed method, experimental research design in a Norwegian Living Lab, Energy Res. Social Sci. 39 (2018) 226–233.
[47] B.K. Sovacool, M. Martiskainen, J. Osborn, A. Anaam, M. Lipson, From thermal comfort to conflict: the contested control and usage of domestic smart heating in the United Kingdom, Energy Res. Soc. Sci. 69 (101566) (2020).
[48] S. Claude, et al., The Living Lab methodology for complex environments: Insights from the thermal refurbishment of a historical district in the city of Cahors, France, Energy Res. Soc. Sci. 32 (2017) 121–130.
[49] W. Canzler, et al., From "living lab" to strategic action field: Bringing together energy, mobility, and Information Technology in Germany, Energy Res. Social Sci. 27 (2017) 25–35.
[50] T. Jack, Negotiating Conventions: cleanliness, sustainability and everyday life, in Department of sociology, Faculty of social science. 2018, Lund University.
[51] L. Yates, D. Evans, Dirtying Linen: Re-evaluating the sustainability of domestic laundry, Environ. Policy Govern. 26 (2016) 101–115.
[52] S. Watson, Mundane objects in the city: Laundry practices and the making and remaking of public/private sociality and space in London and New York, Urban Studies 52 (5) (2015) 876–890.
[53] B. Anderson, Laundry, energy and time: Insights from 20 years of time-use diary data in the United Kingdom, Energy Res. Social Sci. 22 (2016) 125–136.
[54] H. Chappells, E. Shove, Debating the future of comfort: environmental sustainability, energy consumption and the indoor environment, Build. Res. Informat. 33 (1) (2005) 32–40.
[55] E. Shove, G. Walker, S. Brown, Material culture, room temperature and the social organisation of thermal comfort, J. Mater. Culture 19 (2) (2014) 113–124.
[56] M. Sahakian, Keeping Cool in Southeast Asia: Energy use and urban air-conditioning. Energy, Climate and Environment Series, ed. D. Elliott. 2014, New York, London, UK, Palgrave Macmillan.
[57] J. Lave, E. Wenger, Situated learning: Legitimate peripheral participation. 2009 ed. 1991 / 2009, New York: Cambridge University Press.
[58] R. Hitchings, People can talk about their practices, Area 44 (1) (2012) 61–67.
[59] A.L. Browne, Can people talk together about their practices? Focus groups, humour and the sensitive dynamics of everyday life, Area 48 (2) (2016) 198–205.
[60] T. Jack, H. Wilhite, Sovereign dupes? Representations, conventions and (un) sustainable consumption, J. Consum. Cult. (2020), https://doi.org/10.1177/1469540520935945.
[61] G. Wallenborn, H. Wilhite, Rethinking embodied knowledge and household consumption, Energy Res. Social Sci. 1 (2014) 56–64.
[62] S. Laakso, C.L. Jensen, E. Vadovics, et al., Towards sustainable and sufficient energy consumption: Challenging heating-related practices in Denmark, Finland and Hungary. J. Clean. Product. under review.
[63] G. Kallis, Limits: Why Malthus was wrong and why environmentalists shouStanfaord, Stanford University Press, California, 2019.
[64] L. Spengler, Two types of 'enough': sufficiency as minimum and maximum, Environmental Politics 25 (5) (2016) 921–940.